U.S. DEPARTMENT OF COMMERCE • National Oceanic and Atmospheric Administration

SPOTTER'S GUIDE

for Identifying and Reporting

SEVERE LOCAL STORMS

A residential street is smashed to matchwood by the Topeka, Kansas, tornado of June 8, 1966.

Photo by H. E. Hammerli, Christopher Studio.

Cover—A killer tornado stalks Tracy, Minnesota, June 13, 1968. This storm traveled 13 miles along the ground, and killed nine people, injured about 100 more, and caused several million dollars' property damage. A member of Lyon County's effective Severe Local Storm Spotter Network sighted the tornado and alerted Tracy's community warning center, which sounded the Civil Defense sirens for seven minutes before the twister struck the town. Those seven minutes kept the death toll down in Tracy. As a Severe Local Storm Spotter for the National Weather Service you may give your community this gift of time—the seconds that save lives.

Photo by Eric Lantz, Walnut Grove (Minn.) Tribune

To the Severe Local Storm Spotter:

The National Weather Service of NOAA, the U.S. Commerce Department's National Oceanic and Atmospheric Administration, and cooperating organizations have established Severe Local Storm Spotter Networks in order to secure critical information on severe local storms. This Guide is designed to assist you, the spotter, in identifying and reporting these severe local storms. The severe local storm forecaster analyzes the weather and identifies the general areas favorable for severe local storm development. He then issues a severe thunderstorm or tornado *watch*. However, a specific *warning* can be made only after a severe storm is in progress and a report has been received on its type, location, and direction of movement.

This is where you come in. Radar is very important, where available, but it is not the whole answer. We need your reports. Then we can warn others. You are a vital member of the team. Thank you for helping us—and, more importantly, your fellow citizens. Your only compensation will be the knowledge that your vigilance may save lives and property.

Sincerely yours,

R E Hallgren

Richard E. Hallgren
Director, National Weather Service

SEVERE LOCAL STORMS

begin as thunderstorms, the great Cumulonimbus towers built by unstable conditions in the lower atmosphere. Like most storms, thunderstorms run on heat energy converted into wind, electrical discharge, and violent upward motion of the air. Severe local storms may develop from local heating of the ground or radiational cooling of cloud tops—anything which puts dense, colder air above warm, moist, less-dense air.

The Cumulus family of clouds represents such instability. Sometimes one or several fair-weather Cumuli will develop vertically until they become thunderheads; further development causes the thundershower to intensify into a severe local storm.

These disturbances are perhaps most severe when they occur along squall lines, which are generated when cold dense air and warm moist air fight along boundaries called fronts. The greater the contrast in temperature and moisture across the front, the greater the energy content, and the more violent the ensuing thunderstorms.

Because thunderstorms may extend from near the earth's surface into the stratosphere, they may literally blot out the sun. Remember, the darker the sky, the greater the vertical extent of the cloud, and the more likely the storm will be severe. Remember also that, given the proper season and geographic location, severe thunderstorms may develop from shallower cloud systems.

Viewed from below, the ragged bases of a squall line or large thunderstorm are windtorn, twisting, and rolling. This random motion should not be confused with the definite, sustained pattern of rotation about a central point that produces a funnel.

Mammatus cloud forms are series of pouches projecting downward from the base of storm clouds. These pouches are usually uniform in size and shape, appear and flatten gradually, and have no spinning motion.

Although these thunderstorm formations are not tornadoes, they are often observed under tornado-producing severe storm conditions. A storm with developing rotary circulations and mammatus clouds is a storm to watch carefully.

SEVERE LIGHTNING, HEAVY RAINS, DESTRUCTIVE WINDS, AND LARGE, HEAVY HAIL ARE OFTEN "ADVANCE MEN" FOR THE MOST VIOLENT STORM ON EARTH—THE TORNADO.

SKYWARN

You can tell something about a thunderstorm's severity by observing the intensity of its rain and the strength of its winds, and by watching for the occurrence of certain unique, destructive phenomena.

LIGHTNING is the discharge produced when differences in ground and atmospheric electrical charge are large enough to overcome the insulating effect of air. The discharge may occur within the cloud, between clouds, or between the cloud and ground. Usually, the more lightning observed in a thunderstorm, the more intense the storm system. Be careful. Remember that lightning kills more Americans annually than hurricanes or tornadoes.

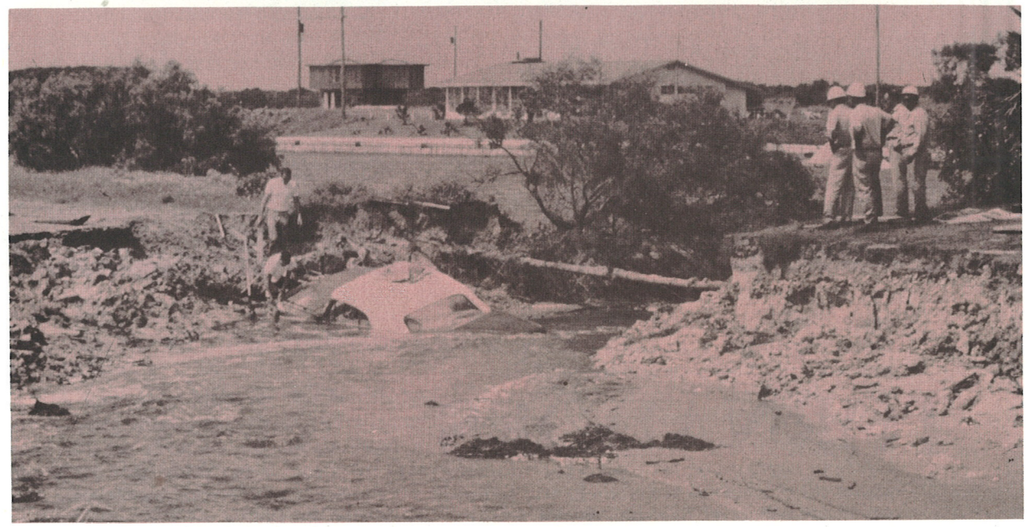
THUNDER is the sound produced by expansion of air heated by the high-amperage lightning stroke. The distance in miles to the lightning flash can be estimated by counting the number of seconds between lightning and thunder, and dividing by five.

HAIL is precipitation in the form of lumps of ice, called hailstones. The size of hailstones is an indicator of thunderstorm intensity.

HEAVY RAINS mark the mature stage of a thunderstorm, and may produce dangerous flash floods even before precipitation ceases. Stay out of dry creek beds during thunderstorms. If you live along a river, listen for flashflood warnings from the National Weather Service.

SKYWARN

REPORT THE DISTANCE AND DIRECTION TO INTENSE, FREQUENT LIGHTNING AND THUNDER AND DESCRIBE THE TYPE OF DISCHARGE: GROUND-TO-CLOUD, CLOUD-TO-CLOUD, CLOUD-TO-GROUND.



REPORT HAILSTONES MORE THAN ¼-INCH IN DIAMETER.

REPORT HEAVY RAIN AND ALL FLOODING

SKYWARN

TORNADOES

are violently rotating columns of air that descend in the familiar funnel shape from thunderstorm cloud systems. A tornado vortex is normally several hundred yards in diameter, whirls usually in a counterclockwise direction (in the Northern Hemisphere), and contains winds estimated to be near 300 miles per hour. Tornadoes occur on all continents, at any time of year, at any hour of the day. They have occurred in every state of the Union.

Their greatest frequency is in the spring, when large contrasts exist between warm air from the south, and cold air from the north; and in the middle and late afternoon, when a warm day is at its warmest. Because they are often accompanied by heavy rain, hail, lightning, and the obscuring cloud system of the thunderstorm or squall line, these violent storms are sometimes difficult to identify. This difficulty is of course much greater when tornadoes occur at night.

You can be an effective spotter if you know what to look and listen for.

LOOK FOR

ANY PROTUBERANCE OR ROTARY MOTION AT THE BASE OF A THUNDERCLOUD SYSTEM

The ragged trailing clouds of squall lines, and certain other harmless phenomena (see pages 14, 15) are frequently mistaken for tornadoes. *Organized rotary motion* about a vertical axis is the clue to distinguishing harmless clouds and the funnel of a developing tornado. In the random motion of thunderstorm clouds, funnel clouds appear as highly organized, rapidly rotating systems. Funnel clouds are violently rotating columns of air, usually pendant from a Cumulonimbus cloud, that do not touch the ground. They become tornadoes only when they reach the surface.

ANY ROTATING CLOUD OF DEBRIS OR DUST NEAR THE GROUND

Some tornadoes drop from a thunderstorm cloud without developing a visible funnel-shaped cloud of their own. These invisible whirlwinds first become visible when the violently spinning column of air begins picking up debris or dust from the ground. The longer such a tornado touches the ground, the darker it becomes as pieces of material are lifted toward the thunderhead. These whirlwinds should not be confused with "dust devils," which are rarely associated with clouds.

LISTEN FOR

THE ROAR OF THE TORNADO'S WINDS

A tornado at night, or one hidden by low-hanging clouds, heavy rain, or buildings can still be detected—its winds have a distinctive roar which can be heard for several miles. Some people have described the sound as that of a big jet aircraft, others, as the sound of trains. When Hurricane Carla (1961) struck Galveston, Texas, some thought the sound of a nighttime tornado Carla spawned was an amphibious tank used in rescue operations. In the January 1969 disaster in Hazelhurst, Mississippi, one survivor thought the pre-dawn twister was the mill whistle, until the house began to shake. The roar of a tornado increases as the funnel nears the ground, and is loudest when the tornado moves across the surface.

REPORT FUNNEL-SHAPED, ROTATING CLOUDS IMMEDIATELY. IF YOU SUSPECT, BUT CANNOT CONFIRM, A SIGHTING, REPORT YOUR SUSPICIONS.

National Weather Service and community warning centers can contact other observers for a better view of the storm. A questionable report, when supported by radar and other observations, can provide enough confirmation for a tornado warning to be issued.

SKYWARN

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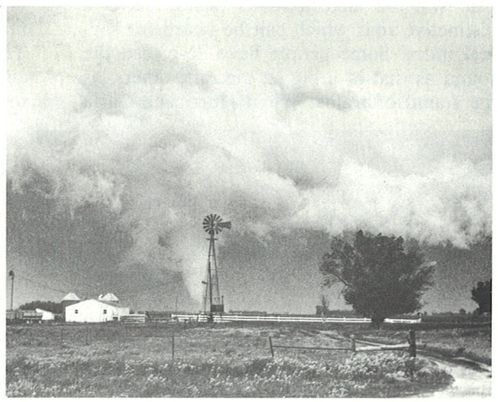

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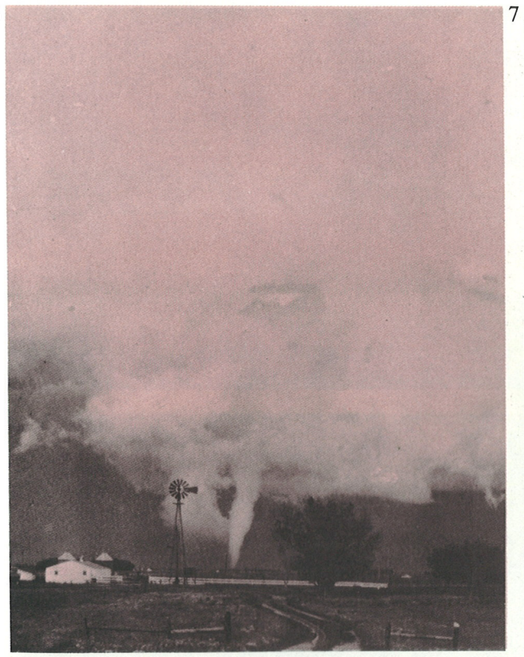

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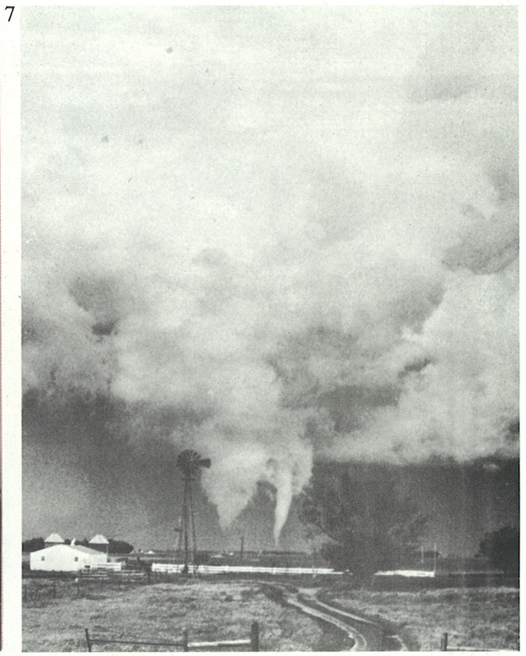

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Life Cycle of a Tornado

A vertical cloud formation (1, to right of Quonset building) descends from the chaotic cloud system of a severe thunderstorm near Freeman, South Dakota, June 1, 1965. Spotter Willis Wipf, who took these pictures, correctly identified the formation as an incipient tornado. A tornado funnel forms (2), and drops toward the surface (3), then lifts and almost disappears before descending to earth (4).

The tornado lifts once more (5), then descends, as a second funnel begins to form (6, behind windmill); the second funnel becomes better defined (7), then dissipates as the tornado begins to lengthen (8), and finally disappears.

2

1

3

4

Mature Tornadoes

assume a variety of shapes and thicknesses, some of which are shown here. In general, mature tornadoes are soon glutted with dust and debris collected in the lower portion of the funnel cloud. The width of the surface cloud of dust and debris is usually much greater than the width of the actual water droplet cloud.

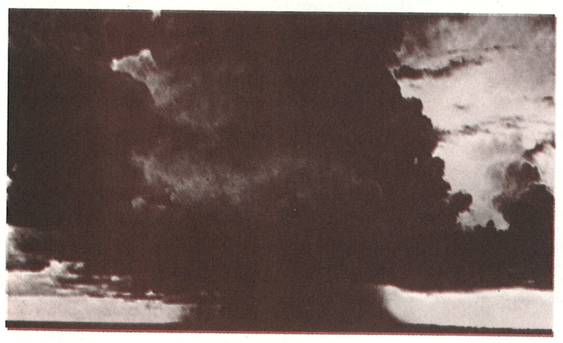
The tornado which struck Dallas, Texas, April 2, 1957 (1) appears as a "typical" funnel-shaped tornado; it is shown at its maximum strength and width (about 500 feet). The Scottsbluff, Nebraska tornado (2) of June 27, 1955, is much fatter than the Dallas storm. The ropelike twister (3) occurred near Enid, Oklahoma, June 5, 1960. The photograph is by Leo Ainsworth. Twin funnels (4) were photographed by Paul Huffman east of Elkhart, Indiana; these were part of the April 11, 1965, "Palm Sunday" tornado outbreak.

Report All Waterspouts

A tornado may pass from land to water or water to land without materially changing its appearance or intensity. A funnel cloud which forms over a body of water and then touches the water is called a waterspout. While over water, the funnel is a cloud of spray instead of the dust and debris found over land. Waterspouts have been observed in conjunction with developing Cumulus clouds as well as thunderstorms.

Fairweather waterspouts resemble their tornado cousins, but appear to develop at the surface, like dust-devils, and rise into the air. Usually a small, isolated cloud forms over the fairweather waterspout.

Shown here as part of a waterspout spectacular in the Bahamas, two spouts run a race across the sea surface as others twist down from thunderclouds.



Thunderstorm weather generates many cloud shapes, circulations, and precipitation patterns which resemble tornadoes—when a severe thunderstorm or squall line is passing your position, the sky sometimes seems to be full of potential tornadoes. Some of these comparatively harmless look-alikes are described below.

Virga, rain or snow falling from a cloud but evaporating before reaching the ground, often suggests a V-shape, broad and diffuse at the cloud base and gradually disappearing downward. In contrast to the vertically drifting rain in this slow-moving formation, a tornado funnel has rapidly twisting particles moving about the funnel cloud.

The rain column of a thundershower, viewed from a distance, may appear as a dark, solid base between the cloud and ground. From the same distance, a tornado appendage would be narrower, and more distinctly outlined.

Often, a low-hanging, ragged accessory cloud is observed on the approaching side of a squall line or large thunderstorm. This cloud extends horizontally over a long distance, and may assume the shape of either a horizontally rolling cylinder or a flat shelf.

The roll cloud, or arcus, is the most common accessory cloud. It appears to be detached from the parent cloud and has a slow, rolling motion about its long, horizontal axis. By contrast, a tornado funnel is attached to the parent cloud and has a fast rotation about its short, nearly vertical axis.

The shelf-shaped accessory cloud has a well-defined upper edge and a ragged base. Because this type of cloud projects forward, a side view may reveal isolated protuberant features. Here, the absence of any twisting motion about a vertical axis eliminates the shelf cloud as a possible tornado.

U.S. DEPARTMENT OF COMMERCE / National Oceanic and Atmospheric Administration

SEVERE LOCAL STORM SPOTTER

Reporting Procedures

1. Telephone severe weather observations *immediately* to the National Weather Service or alternate agency. Place your call through the telephone operator and tell her you have an *emergency call*. If the call is long distance to the National Weather Service, it can be made *collect*. Report promptly; the storm may interrupt communications.

Law enforcement and Civil Defense spotters—report to the National Weather Service via NAWAS, radio, or other direct communications links as prescribed.

From radio-equipped vehicles, report severe weather observations to a central collection point and request them to relay it to the National Weather Service.

2. Tell us briefly

what you have seen: a tornado, waterspout, funnel cloud, heavy hail, destructive wind, or thunderstorm accompanied by frequent lightning.

where you saw it: the direction and distance from a known position to the storm, *e.g.,* 3 miles south of Beltsville.

when you saw it: make sure you note the time of your observation.

what it was doing: describe the storm's direction and speed of travel, intensity, and destructiveness.

3. Give your name and address, or spotter code number, each time you report.

WHEN IN DOUBT, MAKE YOUR REPORT ANYWAY

WHEN A DESTRUCTIVE STORM IS OBSERVED, report by telephone to:

NOAA National Weather Service _____

at _____
(telephone)

Alternate Agency: _____

at _____

_____
(your name)

_____
(your address) (telephone)

_____
(your Spotter Code number)

SKYWARN

For further information, call or write to the National Weather Service office shown above.

☆U.S. Government Printing Office: 1980—341-009/211

For sale by the Superintendent of Documents, U.S. Government Printing Office
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NOAA/PA70011 1975